HHH RLC Bridge IB-5281

125

PARTS LIST

Check each part against the following list. The key numbers in the Parts List correspond to the numbers on the Parts Pictorial (Illustration Booklet, Page 1). Parts may vary slightly from the illustrations; only the hardware is shown actual size.

Some parts are packaged in containers with the part number marked on the outside. Except for the initial parts check, keep these parts in their containers so they can be easily identified when they are called for in the assembly steps.

Save all packaging material until all parts have been located.

To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
RESISTORS				
NOTE: The following resistors have a tolerance of 5%. 5% is indicated by a fourth color band of gold. The resistors may be packed in more than one envelope.				
A1	6-220	2	22 Ω (red-red-black)	R21, R22
A1	6-300	3	30 Ω (orange-black-black)	R36, R41, R42
A1	6-910	1	91 Ω (white-brown-black)	R37
A1	6-101	4	100 Ω (brown-black-brown)	R13, R27, R48, Cal.
A1	6-201	3	200 Ω (red-black-brown)	R32, R50, R52
A1	6-391	1	390 Ω (orange-white-brown)	R15
A1	6-471	2	470 Ω (yellow-violet-brown)	R11, R51
A1	6-511	3	510 Ω (green-brown-brown)	R35, R45, R46
A1	6-561	1	560 Ω (green-blue-brown)	R12
A1	6-102	3	1000 Ω (brown-black-red)	R23, R34, R53
A1	6-202	2	2000 Ω (red-black-red)	R39, R44
A1	6-242	1	2400 Ω (red-yellow-red)	R47
A1	6-302	1	3000 Ω (orange-black-red)	R49
A1	6-432	2	4300 Ω (yellow-orange-red)	R2, R5
A1	6-472	1	4700 Ω (yellow-violet-red)	R10
A1	6-622	1	6200 Ω (blue-red-red)	R43
A1	6-682	1	6800 Ω (blue-gray-red)	R38
A1	6-822	1	8200 Ω (gray-red-red)	R16
A1	6-103	1	10 kΩ (brown-black-orange)	R28

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Resistors (cont'd.)				
A1	6-183	1	18 kΩ (brown-gray-orange)	R40
A1	6-333	1	33 kΩ (orange-orange-orange)	R8
A1	6-433	2	43 kΩ (yellow-orange-orange)	R3, R6
A1	6-104	4	100 kΩ (brown-black-yellow)	R7, R20, R25, R30
A1	6-124	1	120 kΩ (brown-red-yellow)	R17
A1	6-224	2	220 kΩ (red-red-yellow)	R18, R19
A1	6-434	3	430 kΩ (yellow-orange-yellow)	R1, R4, R31
A1	6-105	1	1 MΩ (brown-black-green)	R29
CAPACITORS				
B1	20-102	1	100 pF mica	C7
B2	21-722	2	330 pF ceramic	C1, C2
B2	21-56	1	470 pF ceramic	C12
B2	21-140	2	.001 uF ceramic	C10, C11
B3	25-116	3	50 uF electrolytic	C14, C15, C16
B3	25-117	7	100 uF electrolytic	C3, C13, C17, C18, C19, C20, C21
B4	27-2	1	1 uF Mylar	C9
B5	27-47	3	.1 uF Mylar	C4, C5, C6
B6	29-2	1	10,000 pF (.01 μF) polystyrene	C8

CONTROLS-SWITCHES

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
C1	10-918	1	500 Ω control	R14
C1	10-904	1	5000 Ω control	R33
C1	10-941	1	100 kΩ control	R9
C2	10-1017	1	1000 Ω control	~~R26~~ R24
C3	11-157	1	1000 Ω control	~~R24~~ R26
C4	60-71	1	Slide switch	SW1
C5	63-1303	1	Rotary switch	SW2

DIODES-TRANSISTORS

D1	56-56	3	1N4149 diode	D1, D2, D3
D1	56-89	2	GD510 diode	D4, D5

NOTE: Transistors are marked for identification in one of the following four ways:

1. Part number.
2. Type number.
3. Part number and type number.
4. Part number with a type number other than the one listed.

D2	417-94	2	2N3416 transistor	Q6, Q8
D3	417-235	5	2N4121 transistor	Q3, Q5, Q7, Q9, Q10
D3	417-291	2	2N5458 transistor	Q1, Q2
D3	417-801	1	MPSA20 transistor	Q4

CHOKES - TRANSFORMER

E1	45-99	1	100 uH choke	L1
E2	45-601	1	10 mH choke	L2
E3	46-66	1	1 H choke	L3
E4	51-98	1	Transformer	T1

CONNECTOR - JACKS - PLUG

F1	432-798	2	Battery connector
F2	436-11	2	Red banana jack
F2	436-22	2	Black banana jack
F3	438-14	2	Alligator clip w/banana plug

HARDWARE

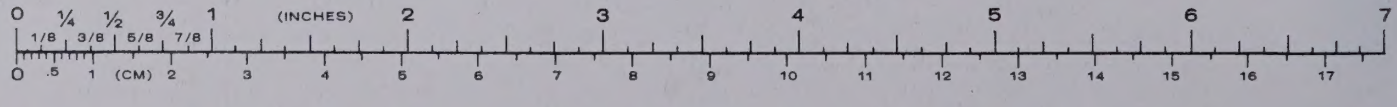
KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
G1	250-56	10	6-32 x 1/4" screw	
G2	250-592	2	#6 x 3/8" self-tapping screw	
G3	250-162	5	6-32 × 1/2" screw	
G4	250-1150	2	6-32 × 1/2" phillips-head screw	
G5	252-3	10	6-32 nut	
G6	254-1	10	#6 lockwasher	
G7	250-22	1	8-32 x 7/16" setscrew	
G8	252-7	2	Control nut	
G9	252-195	5	Self-retaining nut	
G10	253-10	2	Control flat washer	
G11	254-5	2	Control lockwasher	

WIRE

	343-15	1'6"	Shielded cable
	344-50	3'	Black wire
	344-52	4'	Red wire
	344-55	2'6"	Green wire
	344-59	3'	White wire

MISCELLANEOUS

H1	73-64	2	Double-stick foam tape	
H2	73-142	2	Foam square	
	85-1919-1	1	Circuit board	
H3	92-662	1	Cabinet consisting of:	
	92-659	*1*	*Cabinet top*	
	92-660	*1*	*Cabinet bottom*	
	92-661	*1*	*Cabinet cover (assembled to top)*	
	92-668	*1*	*Cover plate*	
H4	200-1290	1	Chassis	
H5	203-1869-1	1	Front panel	
H6	206-1256	1	Bottom shield	
H7	206-1257	1	Top shield	
H8	204-2159	2	Meter clamp	
H9	391-34	1	Blue-and-white label	
H10	407-719	1	Meter	M1
H11	455-50	1	Knob bushing	
H12	462-140	1	Small knob	
	462-314	1	Large knob	
H13	463-28	1	Pointer	
	597-260	1	Parts Order Form	
		1	Assembly Manual (see Page 1) for Part Number)	
			Solder	



6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

   — In the Parts List,

   — At the beginning of each step where a component is installed,

   — In some illustrations,

   — In the Schematic,

   — In the section at the rear of the Manual.

7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

SAFETY WARNING: Avoid eye injury when you cut off excess lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

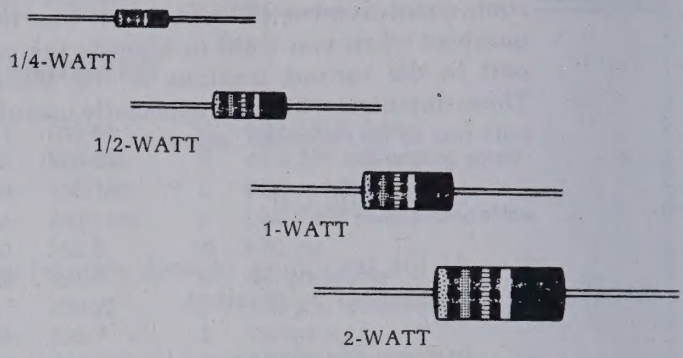
It is easy to make a good solder connection if you follow a few simple rules:

1. Use the right type of soldering iron. A 25 to 40-watt pencil soldering iron with a 1/8" or 3/16" chisel or pyramid tip works best.

2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and re-tinned.

PARTS

Resistors will be called out by their resistance value in Ω (ohms), kΩ (kilohms), or MΩ (megohms). Certain types of resistors will have the value printed on the body, while others will be identified by a color code. The colors of the bands and the value will be given in the steps, therefore the following color code is given for information only.

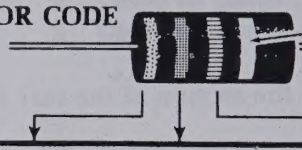


EXAMPLES:

15 × 1,000 = 15,000 Ω (15,000 OHMS), or "15 kΩ"

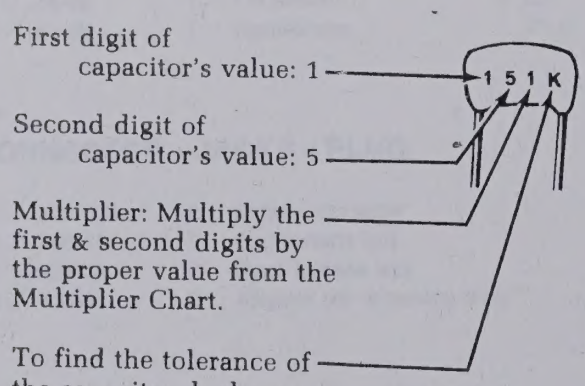
30 × 100,000 = 3,000,000 Ω (or 3 MΩ)
3 MΩ = 3 MEGOHMS

RESISTOR COLOR CODE



COLOR	1st DIGIT	2nd DIGIT	MULTIPLY BY
BLACK	0	0	1
BROWN	1	1	10
RED	2	2	100
ORANGE	3	3	1,000
YELLOW	4	4	10,000
GREEN	5	5	100,000
BLUE	6	6	1,000,000
VIOLET	7	7	10,000,000
GRAY	8	8	100,000,000
WHITE	9	9	1,000,000,000
GOLD			.1
SILVER			.01

Capacitors will be called out by their capacitance value in μF (microfarads) or pF (picofarads) and type: ceramic, Mylar*, electrolytic, etc. Some capacitors may have their value printed in the following manner:



EXAMPLES:

151K = 15 × 10 = 150 pF
759 = 75 × 0.1 = 7.5 pF

NOTE: The letter "R" may be used at times to signify a decimal point, as in: 2R2 = 2.2 (pF or μF).

MULTIPLIER		TOLERANCE OF CAPACITOR		
FOR THE NUMBER:	MULTIPLY BY:	10pF OR LESS	LETTER	OVER 10pF
0	1	±0.1pF	B	
1	10	±0.25pF	C	
2	100	±0.5pF	D	
3	1000	±1.0pF	F	±1%
4	10,000	±2.0pF	G	±2%
5	100,000		H	±3%
			J	±5%
8	0.01		K	±10%
9	0.1		M	±20%

*DuPont Registered Trademark

INTRODUCTION

The Heathkit Model IB-5281 RLC Bridge is a general-purpose instrument that you can use to check the value of resistors, inductors, and capacitors. Use it for bench work with the optional power supply, or as a portable test unit for field use with two standard 9-volt batteries (not supplied). Terminals are provided on the front panel for the component under test (Z_X), and an external standard (Z_S).

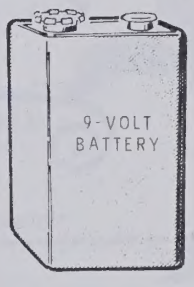
The compact cabinet design matches the 5280 instrument series cabinets. Each cabinet has a convenient storage compartment that lifts for easy access to cables or accessories. The units may be stacked, or placed side by side. This will help you to lay out a neat "test center" arrangement. Each kit in this series is designed for both battery and power supply operation.

The type 5280 series includes the Model IM-5284 Multimeter, the Model IPA-5280-1 Power Supply, and several other kits. If you have purchased the Multimeter, you may want to build it first so that it is available to check the other kits as you assemble them. You may want to build the power supply next to avoid the need for batteries.

BATTERY

If you intend to use batteries, you should purchase two 9-volt transistor batteries, NEDA #1604 at this time for use in your kit. Representative manufacturers and their type numbers are:

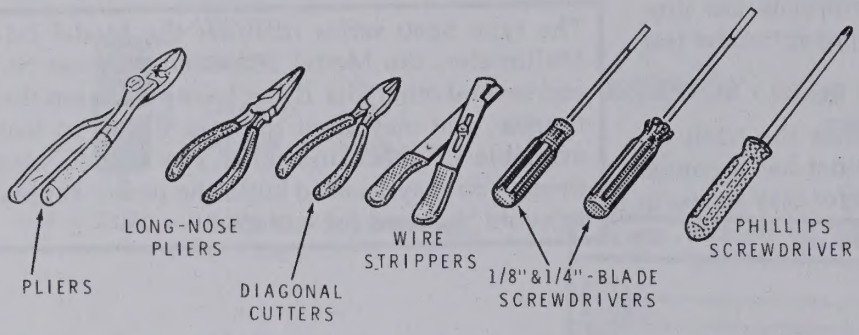
Eveready #216, PP3
Burgess #2U6
Mallory #TR-146X (long life)
RCA #VS323
Hellesens #410
Varta #438
CEI #6F22

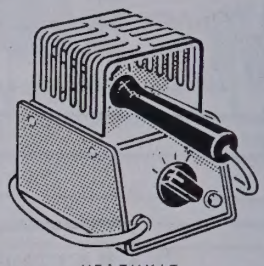


ASSEMBLY NOTES

TOOLS

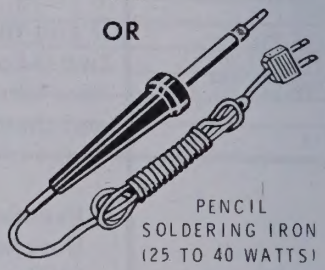
You will need these tools to assemble your kit.





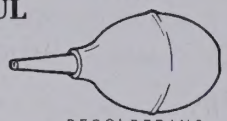
HEATHKIT SOLDERING IRON

OR



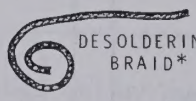
PENCIL SOLDERING IRON (25 TO 40 WATTS)

OTHER HELPFUL TOOLS

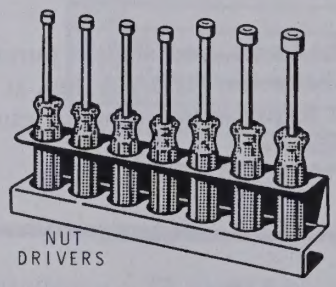


DESOLDERING BULB*

NUT STARTER (MAY BE SUPPLIED WITH KIT)



DESOLDERING BRAID*



NUT DRIVERS

*TO REMOVE SOLDER FROM CIRCUIT CONNECTIONS.

ASSEMBLY

1. Follow the instructions carefully and read the entire step before you perform the operation.

2. The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.

3. Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.

4. Position all parts as shown in the Pictorials.

5. Solder a part or a group of parts only when you are instructed to do so.

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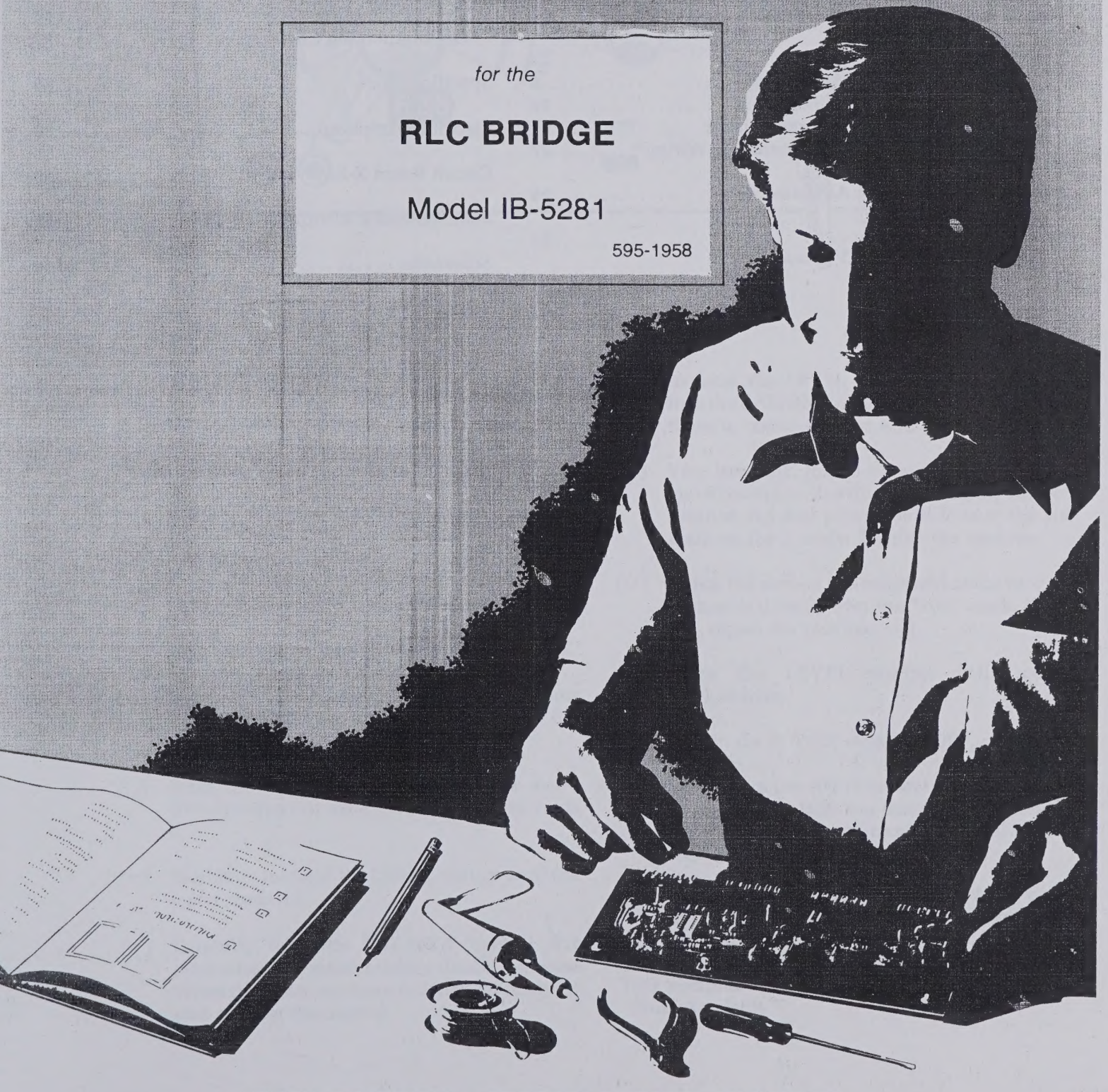
HEATHKIT® MANUAL

for the

RLC BRIDGE

Model IB-5281

595-1958



HEATH COMPANY • BENTON HARBOR, MICHIGAN

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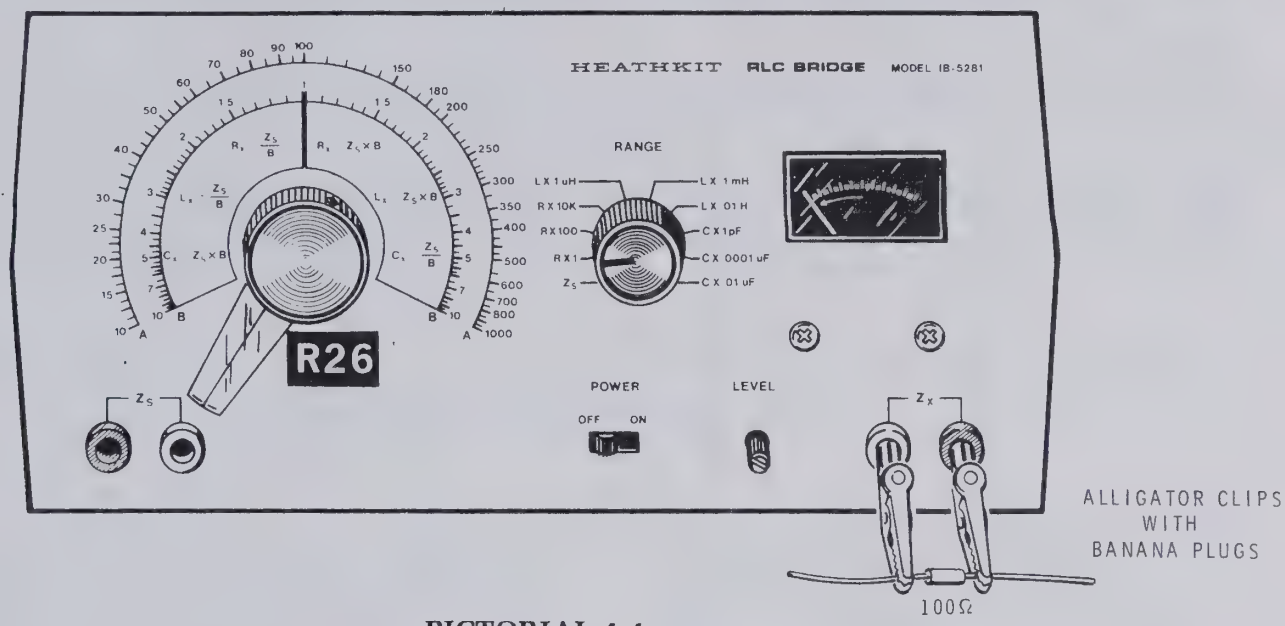


PICTORIAL 4-4

DIAL CALIBRATION

Refer to Pictorial 4-4 for the following steps.

Preset the front panel controls as follows:

( ) BALANCE control R26 fully counterclockwise.

( ) RANGE switch to R×1.

( ) LEVEL control fully counterclockwise.

( ) Plug both alligator clips into the Z_x terminals.

( ) Locate the 100 Ω (brown-black-brown) resistor which was left over, and install it between the two alligator clips as shown.

( ) Place the POWER switch to ON. The meter should swing full scale, then drop back towards 0.

( ) Gradually increase the LEVEL control until the meter reads 10.

( ) Carefully turn the BALANCE control R26 clockwise. The meter reading should decrease. When the meter reaches a null (lowest reading), stop turning the control.

( ) Increase the LEVEL control fully clockwise, rock the BALANCE control back and forth a few times to obtain the best null possible.

( ) Very carefully, loosen the setscrew on the balance control knob without moving the control. Position the dial pointer so it is over the 100 mark on the A scale. Tighten the setscrew.

( ) Check the null on the meter and make sure the pointer is directly over the "100" mark. If it is not, repeat the previous step.

( ) Turn the LEVEL control fully counterclockwise.

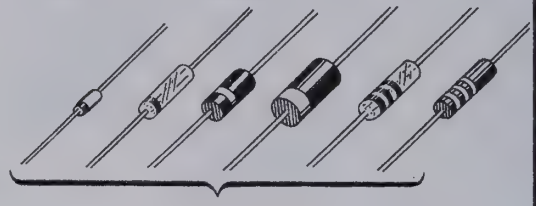
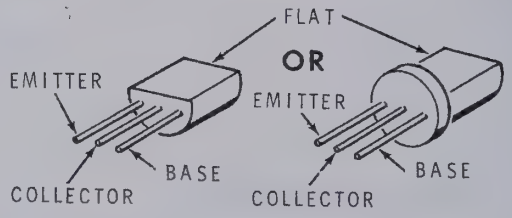
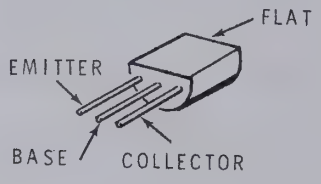
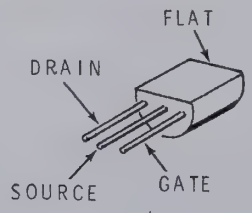
( ) Return the POWER switch to OFF.

( ) Disconnect the 100 Ω resistor and remove the alligator clips from the front panel terminals. Note: Save the resistor in case you would like to recalibrate your unit later.

( ) Remove the plug from the AC receptacle. If you are using the Power Supply, disconnect it from the Bridge.

This completes the "Dial Calibration." Proceed to "Final Assembly."

SEMICONDUCTOR IDENTIFICATION CHART

SCHEMATIC NUMBER	HEATH PART NUMBER	MANUFACTERER'S NUMBER	LEAD IDENTIFICATION
D1, D2, D3	56-56	1N4149	**IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.**  **BANDED END**
D4, D5	56-89	GD510	
Q6, Q8	417-94	2N3416	
Q4	417-801	MPSA20	
Q3, Q5, Q7, Q9, Q10	417-235	2N4121	
Q1, Q2	417-291	2N5458	

9. Read the resistance, indicated by the dial pointer, on the "B" scale. If the dial pointer indicates "1" (center scale), the resistors are of equal value. If the pointer is to the right or left of center scale, the resistors are not of equal value. To determine the value of the unequal resistor (or any component being tested), use the formulas shown inside the "B" scale. If the pointer is to the left of center scale, use the formulas inside the left scale. If the pointer is to the right of center scale, use the formulas inside the right scale. It is normal when you measure extreme values, to have the null occur at a much higher point on the null meter.

NOTE: If you use batteries with your RLC Bridge, measure them with a voltmeter occasionally to make sure they are 7 volts or higher. This will insure the best operation for your bridge.

IN CASE OF DIFFICULTY

This part of the Manual provides you with information that will help you locate and correct difficulties which may occur in your RLC Bridge. This information is divided into two sections. The first section, "General," contains suggestions of a general nature in the following areas:

- Visual check and inspection.
- Precautions to observe when bench testing.

The second section contains a "Troubleshooting Chart" that has a series of "Conditions" and "Possible Causes." Start your troubleshooting procedure by first reading the following "General" section. Then proceed to the appropriate "Condition" and "Possible Cause."

GENERAL

Visual Checks

1. About 90% of the kits that are returned for repair do not function properly due to poor soldering. Therefore, you can eliminate many troubles by a careful inspection of connections to make sure they are soldered as described in the "Soldering" section of the "Assembly Notes." Re-heat any doubtful connections and be sure all the wires are soldered at places where several wires are connected. Check carefully for solder bridges between circuit board foils.
2. Check to be sure that all transistors are in their proper locations, and are installed correctly.
3. Check the value of each part. Be sure that the proper part has been wired into the circuit, as shown in the Pictorial diagrams and is called out in the wiring instructions. It would be easy, for example,to install a 200 Ω (red-black-brown) resistor in a step that calls for a 1000 Ω (brown-black-red) resistor.
4. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as you check it. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something you have consistently overlooked.
5. Check all component leads connected to the circuit board. Make sure the leads do not extend too far through the circuit board and make contact with other connections or parts.
6. Check all of the wires that are connected to the circuit board or switches to be sure the wires do not touch each other or other lugs. Make sure all wires are properly soldered.
7. If the difficulty still is not cured, read the "Precautions for Bench Testing," then refer to the "Troubleshooting Chart."

OPERATION

This RLC Bridge is a conventional bridge circuit powered by a 1 kHz, 10 kHz, or 100 kHz oscillator. It has a resistance range of 10 ohms to 10 megohms, an inductance range of 10 μH to 10 H, and a capacitance range of 10 pF to 10 μF. An external standard range increases the versatility of this Bridge for the experimenter.

Refer to Pictorial 6-1 (Illustration Booklet, Page 7) for a brief description of the controls, meter, and terminals.

NOTE: It is always best to connect the component under test directly to the Z_x terminals. Long leads may pick up stray AC fields and give inaccurate readings. If you use test leads, keep them as short as possible.

USING THE BRIDGE

NOTE: The following procedure uses a resistance measurement as an example. Inductance or capacitance measurements are made with the same procedure. Make sure you change the RANGE switch to the appropriate setting when you measure different types of components. Refer to Pictorial 6-1 (Illustration Booklet, Page 7) for a description of the controls.

To test an unknown resistance, perform the following steps.

1. Turn the LEVEL control fully counterclockwise.
2. Turn the RANGE switch knob to the proper "R" multiplier. If you do not know the resistance value, switch to the RX 1 position as a start.
3. Place the POWER switch to ON.
4. Connect the unknown resistance to the Z_x terminals.
5. Advance the LEVEL control for an approximate full-scale meter reading (10).
6. Adjust the BALANCE control for a null (minimum deflection) on the meter. If you do not obtain a null, switch to the next highest "R" multiplier.
7. Turn the LEVEL control clockwise for an approximate full-scale reading and carefully readjust the BALANCE control for any further null on the meter.
8. Read the resistance, indicated by the dial pointer, on the "A" scale. Multiply the reading by the RANGE switch setting.

USING AN EXTERNAL STANDARD

The following description gives only one typical example for the external standard function. You may want to use the external standard for other applications. When you use the external standard function, make sure you keep the two component values within a 10:1 ratio; otherwise, you will not obtain a null. A null is the lowest reading obtained on the meter. You will not always obtain a "0" reading when you null your meter.

EXAMPLE:

To match several 100 Ω resistors of an unknown value with a 100 Ω resistor of a known value to obtain a matched pair, perform the following:

1. Turn the LEVEL control fully counterclockwise.
2. Set the RANGE switch to the Z_s position.
3. Connect the 100 Ω resistor of a known value to the Z_s (external standard) terminals.
4. Place the POWER switch to ON.
5. Connect a 100 Ω resistor of an unknown value to the Z_x terminals.
6. Advance the LEVEL control clockwise for an approximate full-scale meter reading.
7. Adjust the BALANCE control and obtain a null on the meter.
8. Turn the LEVEL control clockwise for a full-scale meter reading and carefully readjust the BALANCE control for a null on the meter.

SPECIFICATIONS

Resistance Ranges	10 Ω to 10 MΩ in three ranges.
Inductance Ranges	10 μH to 10 H in three ranges.
Capacitance Ranges	10 pF to 10 μF in three ranges.
Oscillator Frequencies	1 kHz, 10 kHz, 100 kHz.
External Standard Range	1:1 to 10:1
Power Supply	(2) 9-volt batteries, and/or Heathkit Model IPA-5280-1 Power Supply.
Cabinet Dimensions	11″ wide × 5-3/4″ high × 7-3/4″ deep (27.9 × 14.6 × 19.7 cm).
Net Weight	3-1/2 lbs. (1.6 kg).

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

Refer to the Block Diagram (Illustration Booklet, Page 8) and Schematic Diagram (fold-in) as you read the "Circuit Description".

Part 1 of Pictorial 7-1 shows the configuration for a Wheatstone Bridge. When all the values of R are equal, the voltage at point A will equal the voltage at point B and the meter will indicate "0" (no current flow) or a "balanced bridge."

Assume that R3 is an unknown value. If the bridge becomes unbalanced, the voltages at points A and B become unequal, and the meter deflects and indicates the difference voltage. By adjusting R1 to give a balanced bridge condition, you will now know the value of R3, since it is equal to R1. R1 is usually a calibrated control or a step-type variable resistor for convenience of adjustment and readout.

Precautions for Bench Testing

- Test transistors carefully. Although they have almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage and current than other circuit components.

- Be careful you do not short any test points to ground when you make voltage measurements. If the probe slips, for example, and shorts out a bias or voltage supply point, it may damage one or more components.

Do not remove any components from the circuit board while the RLC Bridge is turned on.

When you make repairs to the RLC Bridge, make sure you eliminate the cause as well as the effect of the trouble. If, for example, you find a damaged resistor, make sure you find out what (wiring error, etc.) caused the resistor to become damaged. If the cause is not eliminated, the replacement resistor may become damaged when the Bridge is put back into operation.

Refer to the "X-Ray Views," "Identification Charts," and the "Schematic Diagram" to locate the various components.

Use a high impedance voltmeter to make the specified measurements in this section.

In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual. Your warranty is located inside the front cover.

TROUBLESHOOTING CHART

This chart lists the "Condition" and "Possible Cause" of several malfunctions. If a particular part or parts are mentioned (Q1 for example) as a possible cause, check that part to see if it was installed and/or wired correctly. It is also possible, on rare occasions, for a part to be faulty and require replacement.

CONDITION	POSSIBLE CAUSE
No DC voltage change at point A when R9 is adjusted.	1. C3 is shorted. 2. Range switch miswired or loose connection. 3. R9 defective. 4. Q1 through Q5 installed incorrectly or shorted. 5. D1, D2 installed backwards.
No AC voltage at point A.	1. C1 through C6 interchanged. 2. C1 open. 3. Open range switch.
No DC bias voltage change at the collector of Q8 when R33 is adjusted.	1. Q6 through Q10 installed incorrectly or shorted. 2. C13, C17, shorted.
No meter indication.	1. Q6 through Q10 installed incorrectly or shorted. 2. Range switch miswired or has loose connection. 3. Open meter. 4. Weak batteries.
Meter gives reverse indication.	1. D4, D5 installed backwards. 2. Wires to meter reversed.
Balance control is ineffective. Null occurs off scale.	1. T1 open. 2. Balance control miswired. 3. Component out of range of scale, or Z_s and Z_x ratio too wide.
Level control is inoperative.	1. Level control miswired. 2. T1 open.

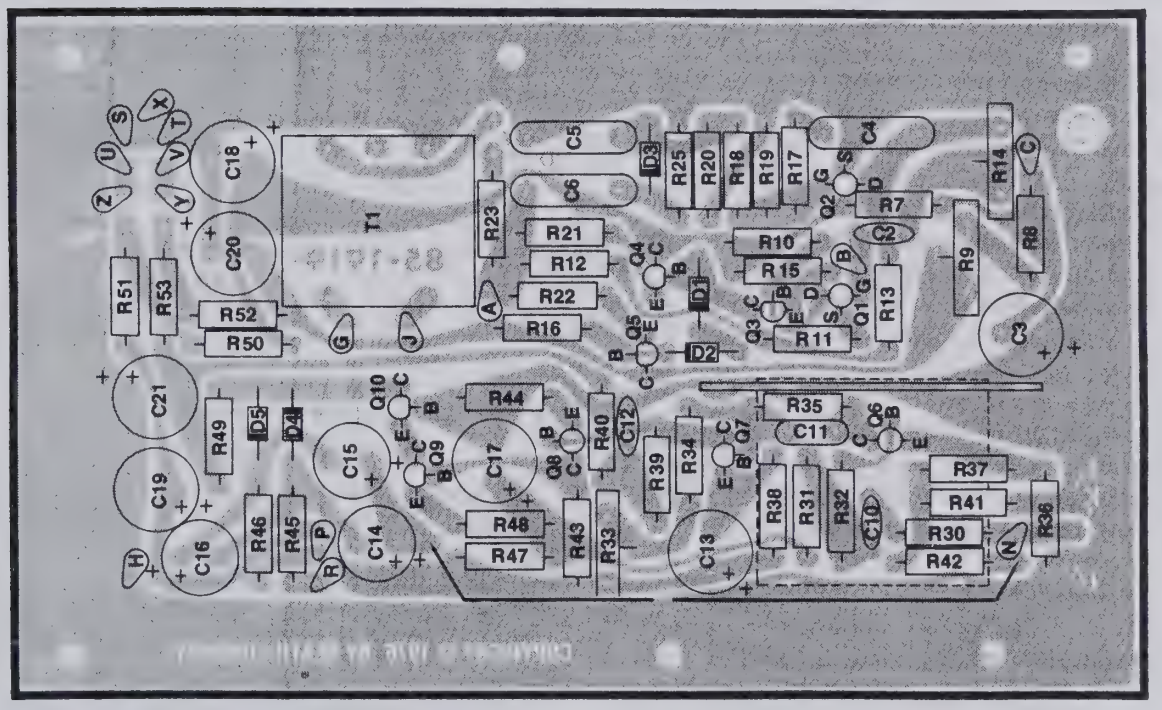
CIRCUIT BOARD X-RAY VIEW

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

A. Find the circuit component number (R5, C3, etc.) on the X-Ray View.

B. Locate this same number in the "Circuit Component Number" column of the "Parts List" in the front of this Manual.

C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.



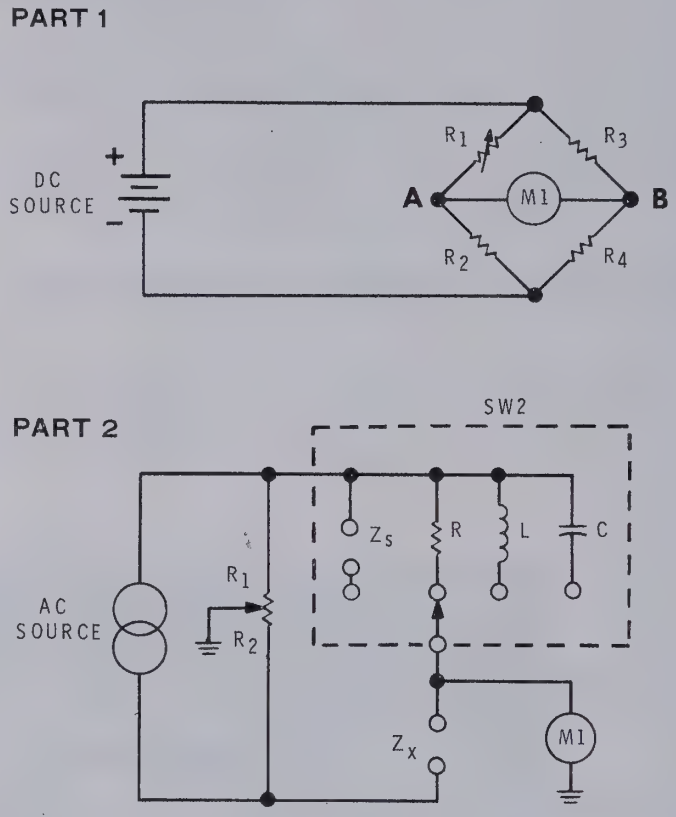
VIEWED FROM COMPONENT SIDE

Part 2 of Pictorial 7-1 shows the configuration for the RLC Bridge. It is basically the same as that of the Wheatstone Bridge. A fixed, internal component standard (Z_s) rather than a calibrated potentiometer (as used in the Wheatstone Bridge), is used in conjunction with the Range switch, SW2. The Range switch selects the multiplication factor and a certain frequency for the type of component being tested. The variable function is provided by a single control, which is divided to act as two arms of the bridge, at R1 and R2. Changing both of these values on the bridge provides a much greater range than a single control would provide.

When you test an unknown component value (Z_X), the known component (Z_S) must be the same type as the unknown component (Z_X). The balance control at R1 and R2 is actually matching the ratio of the unknown component to the known standard. The range switch is marked in R, L, and C values to simplify the readout.

The RLC Bridge circuit uses an AC source rather than a DC type since capacitors and inductors cannot be tested with DC. The AC required to operate the bridge is generated by a Wien bridge oscillator. This oscillator consists of transistors Q1 through Q5. It provides a low impedance output to drive bridge transformer T1. Level control R24 adjusts the oscillator output level to keep meter M1 on scale. The oscillator output voltage is rectified by diode D3 and is used as a control voltage at the gate of transistor Q2. Q2 acts as a variable source resistance for transistor Q1 and controls its gain. The oscillator provides three output frequencies, which are selected by the Range switch for the particular type of component being tested. The frequency used for each range is as follows:

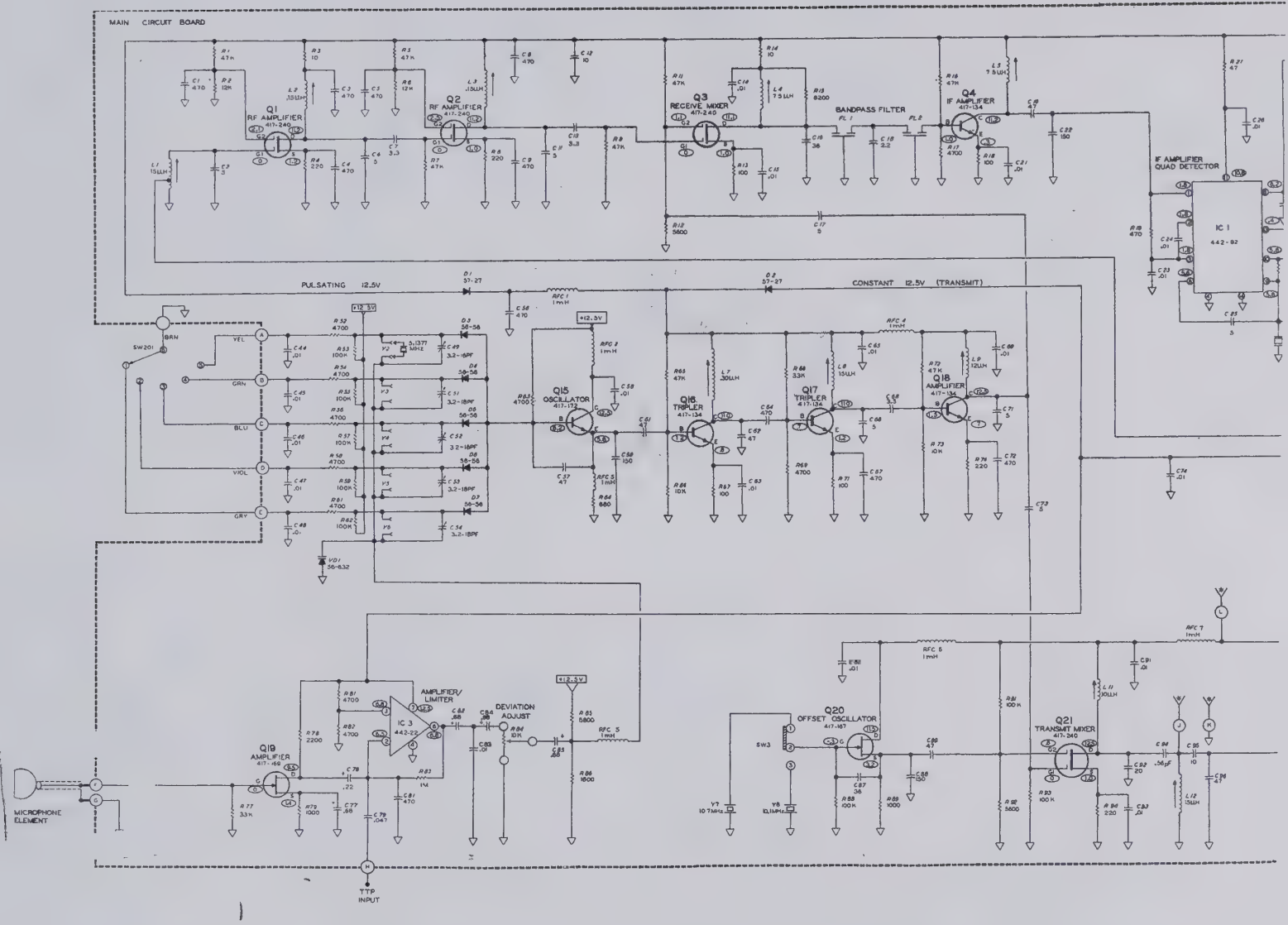
RANGE	FREQUENCY
Z_S (external standard)	1000Hz
R×1	1000 Hz
R×100	1000 Hz
R×10k	1000 Hz
L×1 μH	100 kHz
L×.1 mH	10 kHz
L×.01 H	1000 Hz
C×1 pF	100 kHz
C×F .0001 μF	10 kHz
C×.01 μF	1000 Hz



PICTORIAL 7-1

Meter M1, which indicates a null (or balanced bridge condition), is powered by amplifier stages Q6 through Q10. DC feedback is provided via R31 while AC feedback is provided through the meter circuit via capacitors C14 and C15. Both types of feedback enhance circuit stabilization.

Power is supplied by two 9-volt batteries (see "Introduction" for the type) and/or the Heath Model IPA-5280-1 Power Supply.


MAIN CIRCUIT BOARD
Q1 RF AMPLIFIER 417-240
Q2 RF AMPLIFIER 417-240
Q3 RECEIVE MIXER 417-240
BANDPASS FILTER
Q4 IF AMPLIFIER 417-134
IF AMPLIFIER QUAD DETECTOR
IC 1 442-82
PULSATING 12.5V
CONSTANT 12.5V (TRANSMIT)
SW201
BRN
YEL
GRN
BLU
VIOL
GRY
Q15 OSCILLATOR 417-172
Q16 TRIPLER 417-134
Q17 TRIPLER 417-134
Q18 AMPLIFIER 417-134
Q19 AMPLIFIER 417-169
IC 3 442-22
AMPLIFIER/ LIMITER
DEVIATION ADJUST
Q20 OFFSET OSCILLATOR 417-167
Q21 TRANSMIT MIXER 417-240
SW3
MICROPHONE ELEMENT
TTP INPUT

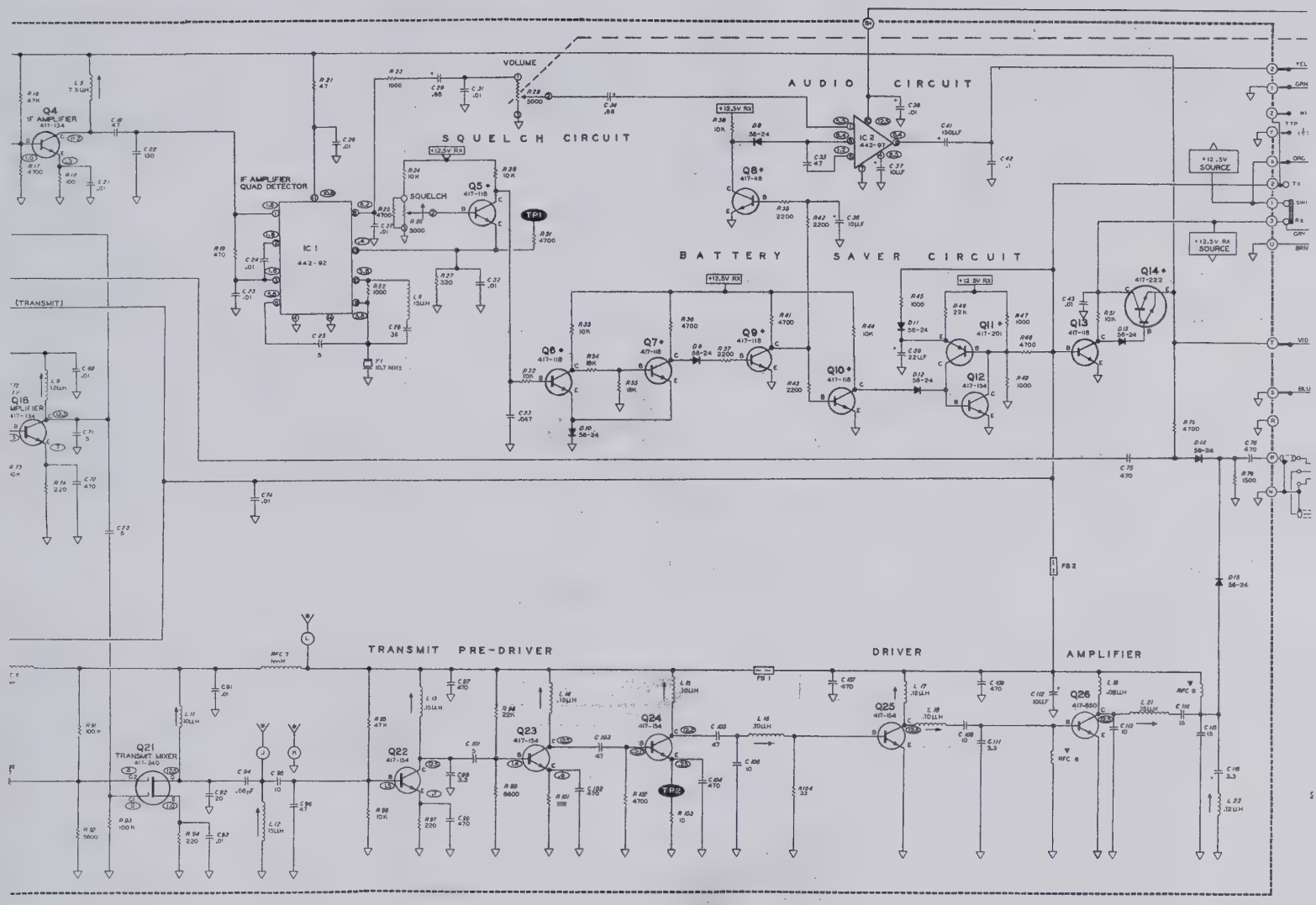


TABLE 1

SQUELCH CONTROL FULLY CLOCKWISE, NO INPUT SIGNAL

	E	B	C
Q5	.4	1.2	.55
Q6	.6	1.2	8.0
Q7	.6	1.3	8.0
Q8	0	.7	.1
Q9	0	.5	3.6
Q10	0	.7	.1
Q11	–	6.0	–

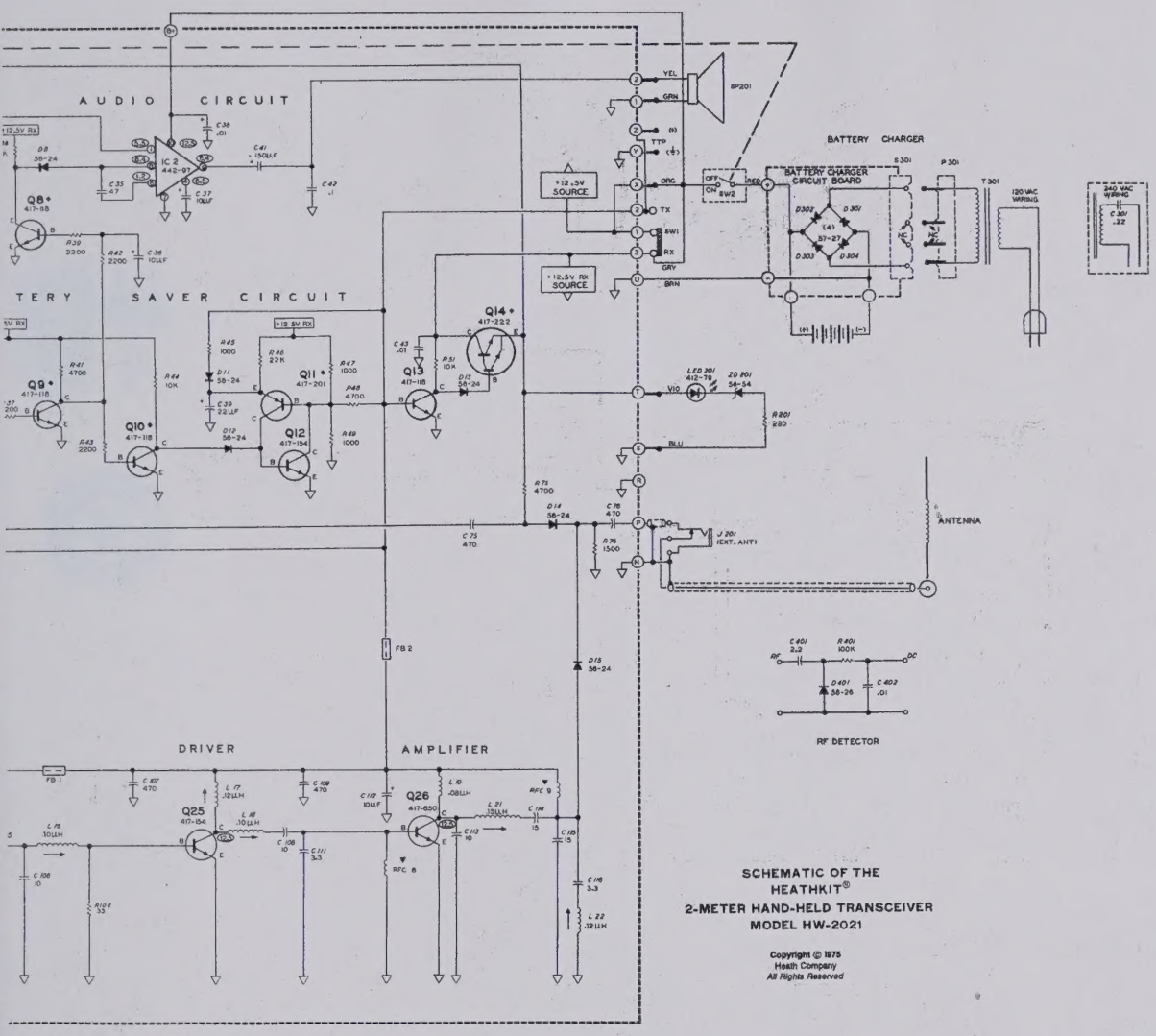
TABLE 2

SQUELCH CONTROL FULLY COUNTER CLOCKWISE, NO INPUT SIGNAL

	E	B	C
Q5	.5	0	7.0
Q6	.6	.6	.8
Q7	.6	.3	5.0
Q8	0	.3	12.5
Q9	0	.7	.1
Q10	0	.1	1.4
Q14	12.5	12.5	11.8

NOTES:

1. COMPONENT NUMBERS ARE IN THE FOLLOWING GROU
   1-199 PARTS ON THE MAIN CIRCUIT BOARD
   201-299 PARTS IN THE CASE.
   301-399 PARTS IN THE BATTERY CHARGER.
   401-499 PARTS ON THE RF DETECTOR.
2. ALL RESISTORS ARE 1/4-WATT, 5% TOLERANCE, UNLI NOTED. RESISTOR VALUES ARE IN OHMS: K=1000, M
3. CAPACITORS EQUAL TO OR LESS THAN .1 ARE IN µF (MICROFARADS). ALL OTHER CAPACITORS ARE IN p (PICOFARADS) UNLESS OTHERWISE MARKED
4. INDUCTORS ARE SHOWN IN MH (MILLIHENRIES) AND (MICROHENRIES).
5. ⬭ THIS SYMBOL INDICATES A DC VOLTAGE ME TAKEN WITH A HIGH INPUT IMPEDANCE VOL THE POINT INDICATED TO CHASSIS GROUND UNDER CONDITIONS



SCHEMATIC OF THE HEATHKIT® 2-METER HAND-HELD TRANSCEIVER MODEL HW-2021

TABLE 1

SQUELCH CONTROL FULLY CLOCKWISE, NO INPUT SIGNAL

	E	B	C
Q5	.4	1.2	.55
Q6	.6	1.2	8.0
Q7	.6	1.3	8.0
Q8	0	.7	.1
Q9	0	.5	3.6
Q10	0	.7	.1
Q11	–	6.0	–

TABLE 2

SQUELCH CONTROL FULLY COUNTER CLOCKWISE, NO INPUT SIGNAL

	E	B	C
Q5	.5	0	7.0
Q6	.6	.6	.8
Q7	.6	.3	5.0
Q8	0	.3	12.5
Q9	0	.7	.1
Q10	0	.1	1.4
Q14	12.5	12.5	11.8

NOTES:

1. COMPONENT NUMBERS ARE IN THE FOLLOWING GROUPS:
   - 1-199 PARTS ON THE MAIN CIRCUIT BOARD.
   - 201-299 PARTS IN THE CASE.
   - 301-399 PARTS IN THE BATTERY CHARGER.
   - 401-499 PARTS ON THE RF DETECTOR.
2. ALL RESISTORS ARE 1/4-WATT, 5% TOLERANCE, UNLESS OTHERWISE NOTED. RESISTOR VALUES ARE IN OHMS: K=1000, M=1,000,000.
3. CAPACITORS EQUAL TO OR LESS THAN .1 ARE IN µF (MICROFARADS). ALL OTHER CAPACITORS ARE IN pF (PICOFARADS) UNLESS OTHERWISE MARKED.
4. INDUCTORS ARE SHOWN IN MH (MILLIHENRIES) AND µH (MICROHENRIES).
5. ⬭ THIS SYMBOL INDICATES A DC VOLTAGE MEASUREMENT TAKEN WITH A HIGH INPUT IMPEDANCE VOLTMETER FROM THE POINT INDICATED TO CHASSIS GROUND UNDER THE FOLLOWING CONDITIONS:
   - A. NO INPUT SIGNAL.
   - B. SQUELCH CONTROL FULLY CLOCKWISE.
   - C. VOLUME CONTROL FULLY COUNTERCLOCKWISE.
   - D. LOWEST FREQUENCY OSCILLATOR CRYSTAL SELECTED.
   - E. TRANSMITTER VOLTAGES: KEYED WITHOUT MODULATION.
6. ⏚ THIS SYMBOL INDICATES CHASSIS GROUND.
   - ○ THIS SYMBOL INDICATES A SOLDERED CONNECTION TO THE MAIN CIRCUIT BOARD.
   - ◆ SEE TABLES 1 AND 2 FOR VOLTAGES.
   - ▼ THIS SYMBOL DENOTES A CHOKE WOUND BY THE KIT BUILDER.
7. REFER TO THE "CIRCUIT BOARD X-RAY VIEWS" FOR THE PHYSICAL LOCATION OF PARTS.
8. (TP) INDICATES TEST POINT.
9. ✱ INDICATES TEST POINT USED ONLY WHEN ALIGNMENT IS PERFORMED WITHOUT INSTRUMENTS.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